US009281905B2

(12) **United States Patent**
Loth et al.

(10) **Patent No.: US 9,281,905 B2**
(45) **Date of Patent: Mar. 8, 2016**

(54) **ELECTRICAL INSULATION CONFIGURATION FOR AN ELECTRICAL DEVICE**

(71) Applicants: **Michael Loth**, Germantown, WI (US); **Daniel L. Stewart**, Mequon, WI (US); **Raymond Sladky**, Grafton, WI (US); **Daniel Pixler**, West Bend, WI (US)

(72) Inventors: **Michael Loth**, Germantown, WI (US); **Daniel L. Stewart**, Mequon, WI (US); **Raymond Sladky**, Grafton, WI (US); **Daniel Pixler**, West Bend, WI (US)

(73) Assignee: **Rockwell Automation Technologies, Inc.**, Mayfield Heights, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 204 days.

(21) Appl. No.: **13/770,723**

(22) Filed: **Feb. 19, 2013**

(65) **Prior Publication Data**

US 2014/0001382 A1 Jan. 2, 2014

Related U.S. Application Data

(60) Provisional application No. 61/665,735, filed on Jun. 28, 2012.

(51) **Int. Cl.**

H04B 10/00	(2013.01)
H04B 10/80	(2013.01)
H02H 1/00	(2006.01)
H02H 5/12	(2006.01)

(52) **U.S. Cl.**
CPC ***H04B 10/802*** (2013.01); ***H02H 1/00*** (2013.01); ***H02H 5/12*** (2013.01)

(58) **Field of Classification Search**
CPC H04B 10/80; H04B 10/802; H02H 1/00; H02H 9/00
USPC .... 250/551, 214 R; 361/23, 43; 307/326; 324/551
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,178,617 A * 12/1979 Reichel 361/43
4,768,125 A * 8/1988 Byrne 361/32

OTHER PUBLICATIONS

Been, et al., Designing Medical Devices for Isolation and Safety, EDN, May 24, 2007, pp. 75-78.
Avago Technologies, Safety Considerations When Using Optocouplers and Alternative Isolators for Providing Protection Against Electrical Hazards, White Paper, pp. 1-6, Copyright 2005-2010 Avago Technologies, AV02-1909EN-Jan. 29, 2010.
Khan, Optocouplers for Variable Speed Motor Control Electronics in Consumer Home Appliances, White Paper, pp. 1-22, Copyright 2006-2010 Avago Technologies Limited, Obsoletes 5989-1059EN AV02-2420EN-Mar. 23, 2010.

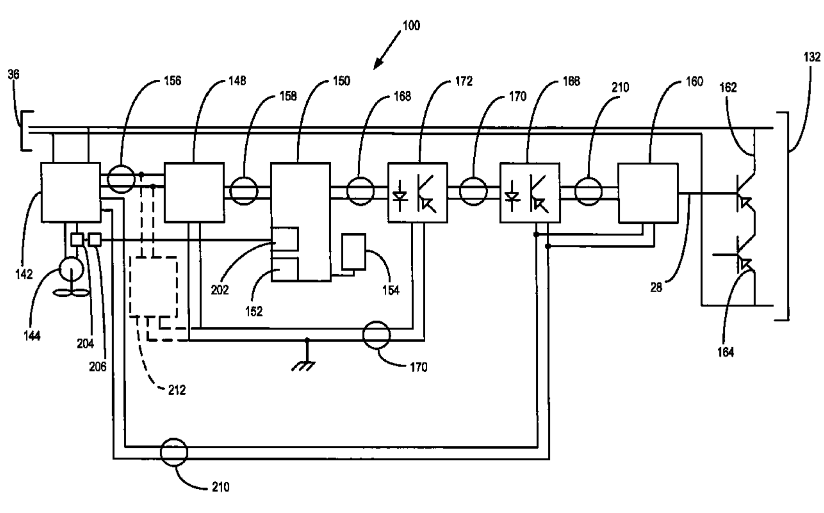
* cited by examiner

Primary Examiner — Kevin Pyo
(74) *Attorney, Agent, or Firm* — Quarles & Brady LLP

(57) **ABSTRACT**

An electrical insulation configuration for an electrical device having a power circuit includes a first insulation device to provide a level of basic insulation between the power circuit and a user, and an additive insulation device in series with the first insulation device, the additive insulation device to increase the level of basic insulation to a level of double insulation or reinforced insulation between the power circuit and the user.

19 Claims, 5 Drawing Sheets



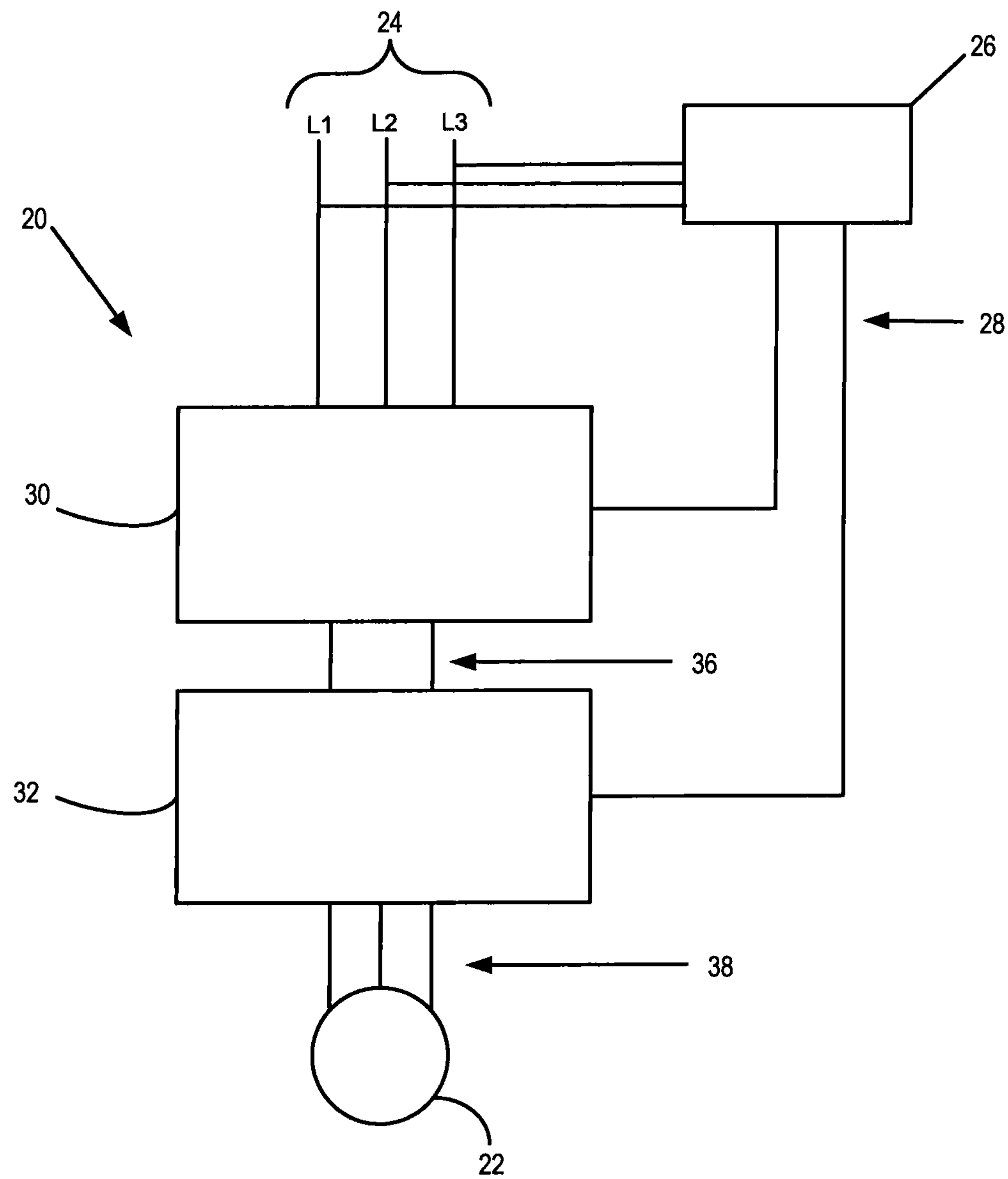


FIG. 1

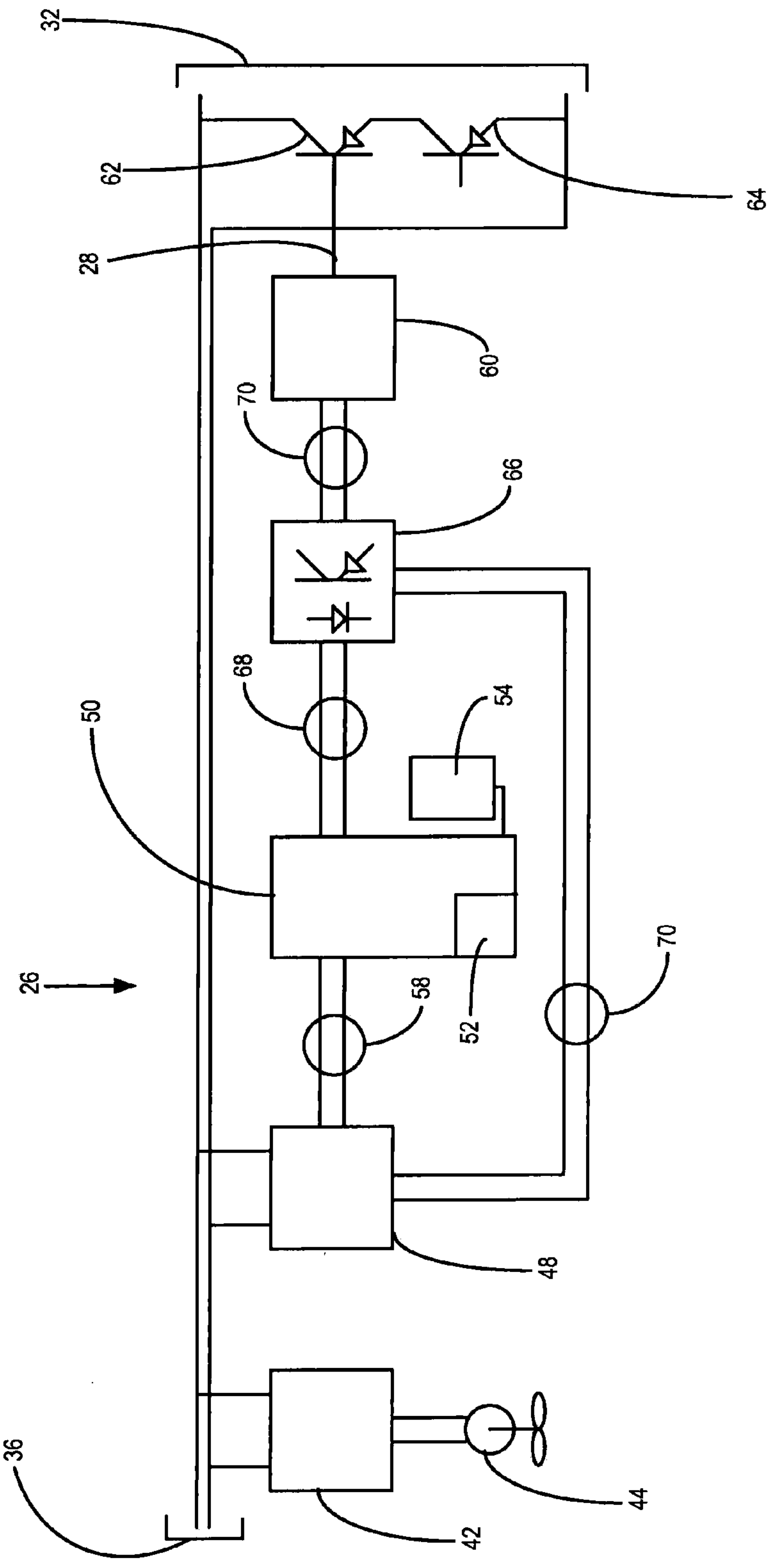


FIG. 2

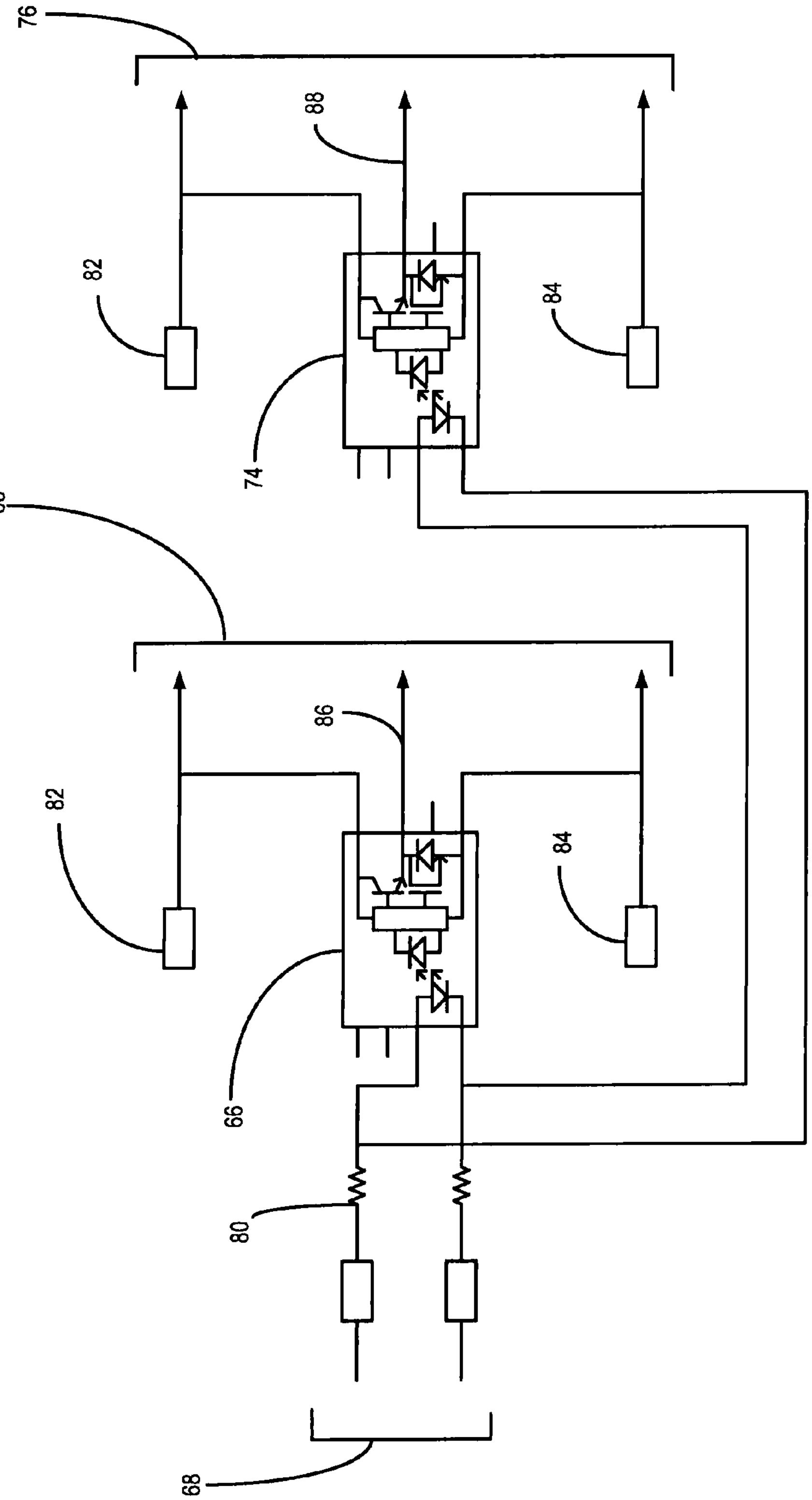


FIG. 3

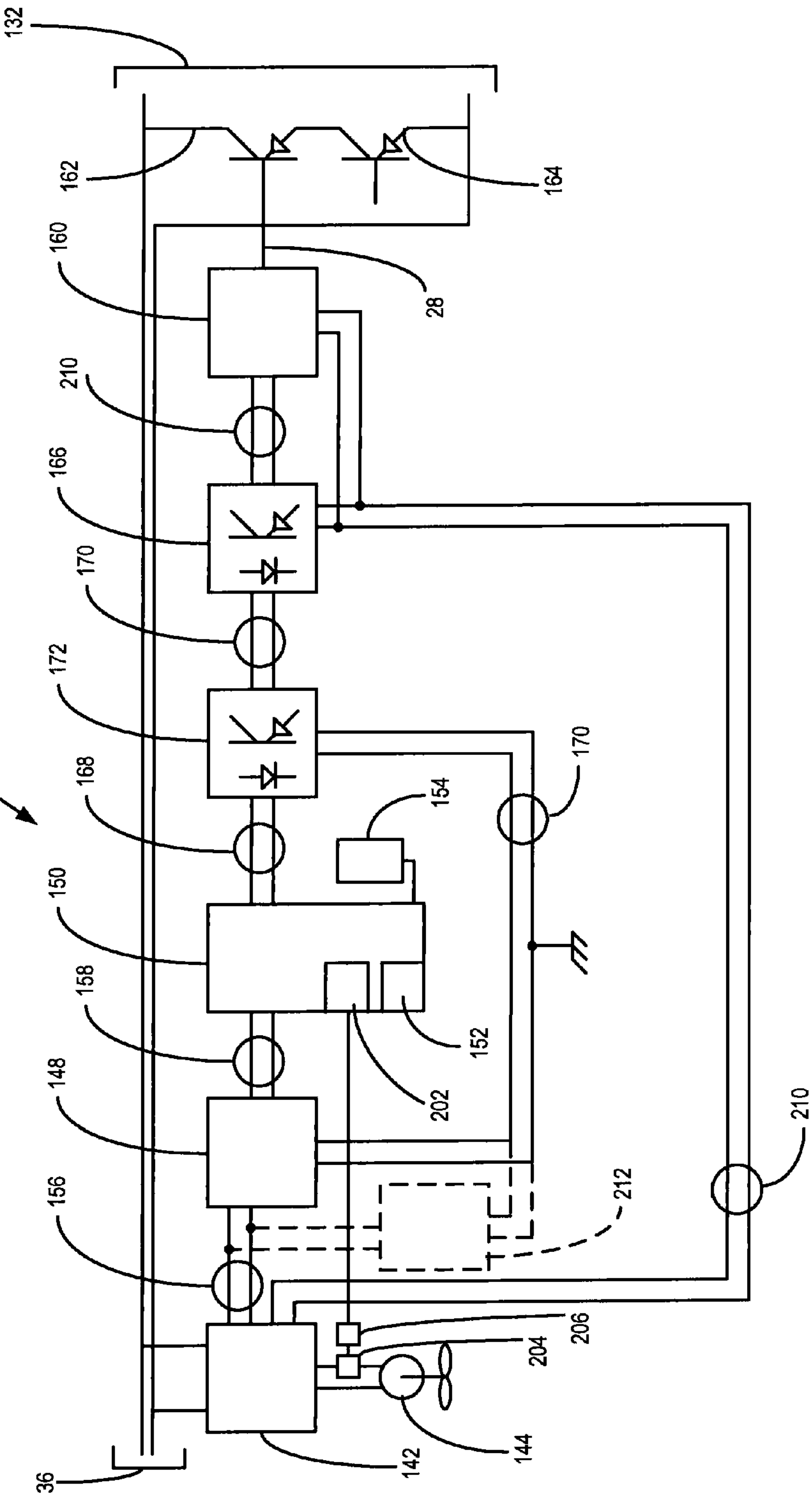

132
162
164
160
28
210
166
170
172
100
168
154
170
150
158
152
202
148
210
212
156
206
204
144
142
36

FIG. 4

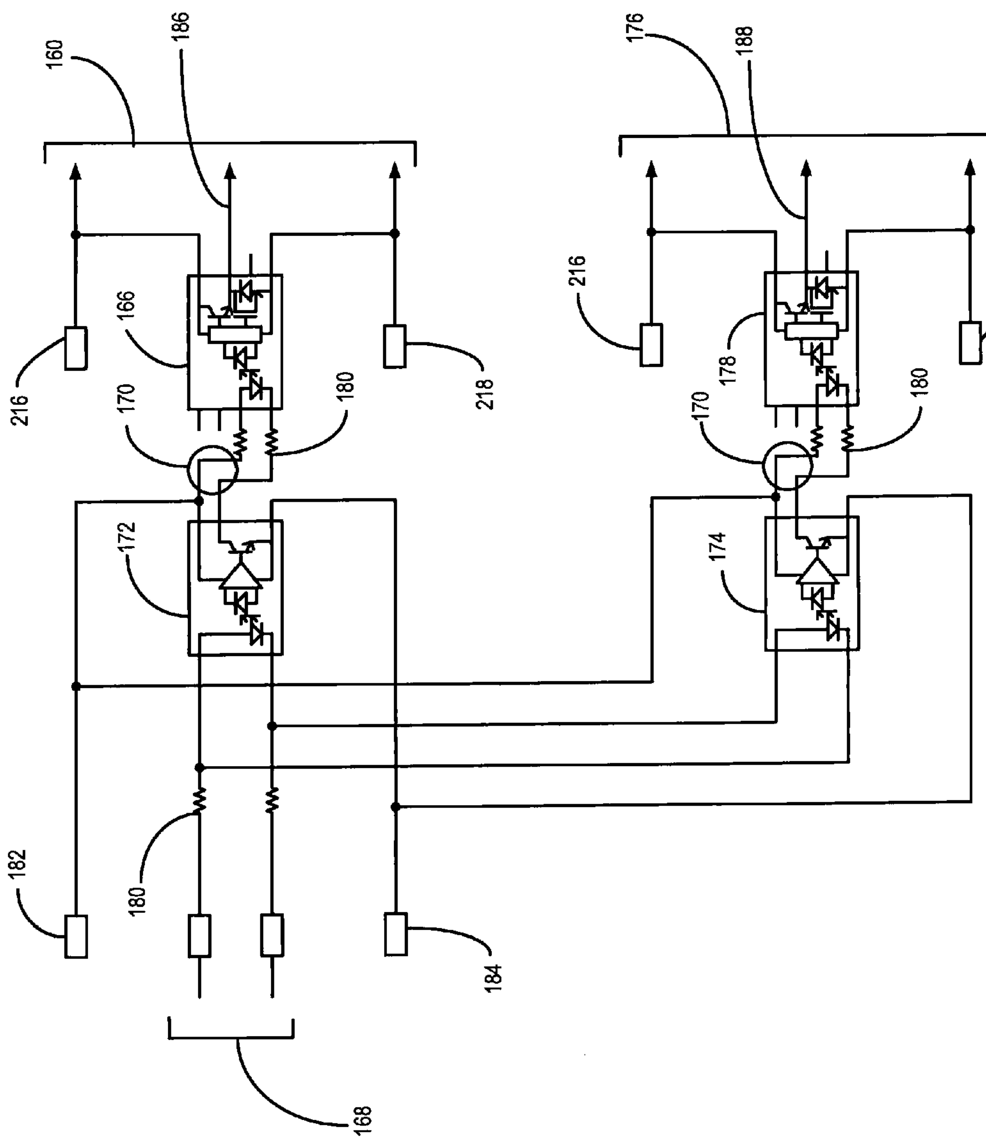


FIG. 5

ELECTRICAL INSULATION CONFIGURATION FOR AN ELECTRICAL DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/665,735, filed Jun. 28, 2012, and entitled "ELECTRICAL INSULATION CONFIGURATION FOR AN ELECTRICAL DEVICE," which is hereby incorporated by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

BACKGROUND OF THE INVENTION

The subject matter disclosed herein relates generally to an electrical insulation configuration for an electrical device, and, more particularly, to an electrical insulation configuration to provide electrical insulation between a power circuit and a user.

The use of ac-line-powered electrical devices, such as commercial devices, medical devices, and industrial equipment potentially exposes users of these devices to the possibility of electrical contact, burns, etc. due to the possibility of a breakdown in electrical insulation. As a result, many regulations from agencies ranging from the US FDA (Food and Drug Administration), European Commission, UL (Underwriters Laboratories Inc.), CSA (Canadian Standards Association) and other safety and regulatory bodies ensure that these devices comply with appropriate safety standards. For example, IEC (International Electrotechnical Commission) 60601-1 defines medical-equipment electrical-safety conditions necessary to protect patients, operators, and the surroundings, and IEC 61800-5-1 establishes electrical safety requirements for variable speed drives.

In electrical equipment, designers can isolate touch-safe low voltage circuitry from high-voltage circuitry using devices which provide electrical isolation such as optocouplers or transformers. The devices used to provide isolation between low voltage and high voltage circuits typically employ an insulation system based upon air spacings and solid insulation. When air is used as insulation between conductors such as component leads, the electrical safety standards require a minimum distance through air (clearance) and over an insulating surface (creepage). Likewise, when solid insulation such as plastic or ceramic is used between conductors, the standards require the insulating material to satisfy performance requirements determined by tests such as an AC voltage test, impulse test, or partial discharge test.

For example, for a 690V inverter, IEC 61800-5-1 requires 8 mm clearance between power circuits and the grounded chassis of the inverter; this is called "basic" insulation. However, devices such as optocouplers, when used to provide isolation between power circuits and low voltage circuits which are accessible to the user, must provide 14 mm clearance between the emitter and detector leads of the device. This increased insulation requirement is called "reinforced" or "double" insulation. A variety of ratings exist for optocouplers. For example, 8 mm, 14 mm, and larger optocouplers exist, but getting into the 14 mm size causes the optocouplers to be bulky and expensive.

It would, therefore, be desirable to provide a reinforced or double level of insulation using smaller, less expensive insulation devices, yet achieve a higher insulation rating.

BRIEF DESCRIPTION OF THE INVENTION

The present embodiments overcomes the aforementioned problems by providing an additive insulation device to an insulation configuration.

In accordance with one embodiment of the invention, an electrical insulation configuration for an electrical device having a power circuit includes a first insulation device to provide a level of basic insulation between the power circuit and a user, and an additive insulation device in series with the first insulation device, the additive insulation device to increase the level of basic insulation to a level of double insulation between the power circuit and the user.

In accordance with another embodiment of the invention, a variable frequency drive includes control circuitry coupled to a power circuit, a power module and an inverter. The control circuitry can include a control pod and a gate driver circuit, the control pod to provide control signals to the gate driver circuit. The control circuitry can include a first insulation device to provide a level of basic insulation between the power circuit and a user of the variable frequency drive. The control circuitry can also include an additive insulation device, the additive insulation device to increase the level of basic insulation to a level of double insulation or reinforced insulation between the power circuit and the user of the variable frequency drive, the additive insulation being electrically positioned between the control pod and the gate driver circuit.

In accordance with another embodiment of the invention, a method for providing additive insulation to an electrical device having a power circuit includes providing a first insulation device for providing a level of basic insulation between the power circuit and a user, and providing an additive insulation device in series with the first insulation device, the additive insulation device for increasing the level of basic insulation to a level of double insulation between the power circuit and the user.

To the accomplishment of the foregoing and related ends, the embodiments, then, comprise the features hereinafter fully described. The following description and the annexed drawings set forth in detail certain illustrative aspects of the invention. However, these aspects are indicative of but a few of the various ways in which the principles of the invention can be employed. Other aspects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The embodiments will hereafter be described with reference to the accompanying drawings, wherein like reference numerals denote like elements, and:

FIG. **1** is a circuit diagram of an exemplary motor drive configuration including power modules coupled to a three phase power source and a motor, with control circuitry coupled to the three phase power source and the power modules;

FIG. **2** is a block diagram of a portion of an electrical device that includes optical insulation;

FIG. **3** is a wiring diagram of a portion of the block diagram of FIG. **2**;

FIG. **4** is a block diagram of a portion of an electrical device showing an embodiment of an additive optical insulation implementation according to an embodiment of the invention; and

FIG. **5** is a wiring diagram of a portion of the block diagram of FIG. **4**, showing the additive optical insulation implementation according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The following discussion is presented to enable a person skilled in the art to make and use embodiments of the invention. Various modifications to the illustrated embodiments will be readily apparent to those skilled in the art, and the generic principles herein can be applied to other embodiments and applications without departing from embodiments of the invention. Thus, embodiments of the invention are not intended to be limited to embodiments shown, but are to be accorded the widest scope consistent with the principles and features disclosed herein.

The detailed description is to be read with reference to the figures. The figures depict selected embodiments and are not intended to limit the scope of embodiments of the invention. Skilled artisans will recognize the examples provided herein have many useful alternatives and fall within the scope of embodiments of the invention. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items.

Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings. As used herein, unless expressly stated otherwise, "connected" means that one element/feature is directly or indirectly connected to another element/feature, and not necessarily electrically or mechanically. Likewise, unless expressly stated otherwise, "coupled" means that one element/feature is directly or indirectly coupled to another element/feature, and not necessarily electrically or mechanically.

The various embodiments of the invention will be described in connection with an optical insulation configuration for a variable speed motor drive. That is because the features and advantages of the invention are well suited for this purpose. Still, it should be appreciated that the various aspects of the invention can be applied in other forms and in other electronic devices that are coupled to a voltage level that may be insulated.

As used herein, various embodiments will be described herein using at least one optocoupler, also called opto-isolator, to provide optical insulation. As used herein, an optocoupler can be an electronic component that transfers an electrical signal or voltage from one part of a circuit to another, or from one circuit to another, while electrically isolating the two circuits from each other. Typically, an optocoupler comprises an infrared emitting LED chip that is optically in-line with a light-sensitive silicon semiconductor chip, all enclosed in the same package. A variety of configurations of optocouplers are known. It is to be appreciated that magnetic isolators, capacitor-coupled isolators, and magnetoresistance isolator technologies may be used in place of or in addition to optocoupler insulators discussed herein.

In terms of electrical insulation, functional, basic, and reinforced insulation, also known as double insulation, are important safety features of UL and CE standards. Certain required levels of electrical insulation insures that when a user is or could be in contact with an electronic device that is electrically coupled to a level of voltage that may pose a voltage potential, the user can be isolated from the voltage potential. It is to be appreciated that the terms insulation and isolation would be known to one of skill in the art to be able to be used interchangeably to describe types of electrical separation.

Turning now to the drawings, and referring initially to FIG. **1**, an exemplary simplified block diagram of an electrical device is shown. In this example, the electrical device is a motor drive configuration **20** that can provide alternating current (AC) electric power to an AC electric motor **22** as is known in the art. Electric power can be provided to the motor drive configuration **20** from a three phase AC input power source **24** comprising AC power source lines L**1**, L**2**, and L**3**. Three phase AC power from the input power source **24** can be provided to a control circuit **26**. The control circuit **26** can provide control signals **28** to a power module **30** and an inverter **32**. The power module **30** then produces a DC voltage on a DC bus **36** as is known in the art. Power modules are also known in the art as IGBTs, bridge rectifiers or SCR bridges, for example.

The DC voltage on the DC bus **36** can then be received by the inverter **32** that synthesizes a new three-phase power **38** provided to the AC motor **22**. By converting the original three-phase power to DC and then back into three-phase AC power **38**, the frequency, amplitude, and phase of the motor voltages and currents may be adjusted for precise motor control.

In other motor drive configurations, DC power from the DC bus **36** can be applied to a DC motor in a manner known in the art in order to provide DC power of appropriate amplitude and phase to a DC motor in a controlled fashion.

FIG. **2** illustrates a simplified block diagram of a portion of the motor drive configuration **20** of FIG. **1**. The block diagram of FIG. **2** shows an exemplary embodiment of a control circuit **26** usable with the motor drive configuration **20**, or other motor drive configurations. In this embodiment, electric power can be provided to the motor drive configuration **20** from a 480 VAC input power source **24**, although other voltages are possible. As can be seen, in this embodiment, power for the control circuit **26** can be provided from the DC bus **36**. The DC bus **36** can be a source of high voltage, and therefore a basic level of insulation is preferably provided with the motor drive configuration **20** to reduce the level of voltage potential to a user of the motor drive configuration.

The control circuit **26** can draw power from the DC bus **36**. Additional devices, such as a fan power supply **42** can also draw power from the DC bus **36**. The fan power supply **42** can reduce the high voltage DC bus **36** down to a lower voltage level to supply a fan **44**. Depending on the configuration of the fan power supply **42** and fan **44**, insulation may be provided between the high voltage DC bus **36** and the lower voltage level supplied to the fan **44**.

As part of the control circuit **26**, a control power supply **48** can draw power from the DC bus **36**. The control power supply **48** can reduce the high voltage DC bus **36** down to a lower voltage level to supply other control devices, such as a control pod **50**. The control pod **50** can provide a user interface **52** to the motor drive configuration **20**. Alternatively, or in addition to, a human interface module **54** can be coupled to the control pod **50** to allow a user to interact with the control pod **50** of the motor drive configuration **20**. The control power supply **48** can provide a basic level of solid insulation between the high voltage DC bus **36** and a user accessible lower voltage (UALV) **58** supplied to the control pod **50**.

Based on user input to the control pod **50**, and/or the human interface module **54**, the control pod **50** can provide the control signals **28** to a gate driver circuit **60** to control the operation of the inverter **32**. The inverter **32** is shown including only two IGBTs **62** and **64** for simplicity, although more are commonly used as is known in the art. An optocoupler **66** can be positioned between the control pod **50** and the gate driver circuit **60** to provide a basic level of insulation. For example, the optocoupler **66** can be a HCNW3120 optocoupler, for example, from Avago Technologies that can provide 8 mm of creepage clearance and 8 KV of impulse voltage protection. The optocoupler **66** isolates a UALV **68** from the control pod **50** and a high voltage power **70** provided by the control power supply **48** to the optocoupler **66**. The UALV **58** and the UALV **68** need not be at the same lower voltage potential. The high voltage power **70** can also be present between the optocoupler **66** and the gate driver circuit **60**.

FIG. **3** illustrates a more detailed wiring diagram of a portion of the block diagram of FIG. **2**. Specifically, FIG. **3** illustrates the wiring of the optocoupler **66** coupled to the gate driver circuit **60** for IGBT **62**, and an optocoupler **74** coupled to a gate driver circuit **76** for IGBT **64**. As can be seen, the UALV **68** can be coupled to both optocouplers **66** and **74**. Resistors **80** may be included in line with the UALV **68**.

Low voltage power **68** can be provided to both optocouplers **66** and **74** in the form of a low voltage power **82** and a low voltage return **84**. Low voltage power **82** and low voltage return **84** are also provided to the gate driver circuit **60** and the gate driver circuit **76**, along with gate driver signal **86** for the gate driver circuit **60**, and gate driver signal **88** for the gate driver circuit **76**.

Referring now to FIG. **4**, an exemplary embodiment of a control circuit **100** usable with the motor drive configuration **20**, or other motor drive configurations, incorporates additive insulation (e.g., optical insulation) according to embodiments of the invention. In this embodiment, electric power can be provided to the motor drive configuration **20** from a 690 VAC input power source **24**, although other voltages are possible.

As can be seen, in this embodiment, power for the control circuit **100** can be provided from the DC bus **36**. The DC bus **36** can be a source of high voltage, and therefore a reinforced or double level of insulation is preferably provided with the motor drive configuration **20** to reduce the level of voltage potential to a user of the motor drive configuration.

The control circuit **100** can draw power from the DC bus **36**. Additional devices, such as a fan power supply **142** can also draw power from the DC bus **36**. The fan power supply **142** can reduce the high voltage DC bus **36** down to a lower voltage level to supply a fan **144**. Depending on the configuration of the fan power supply **142** and fan **144**, isolation may be provided between the high voltage DC bus **36** and the lower voltage level supplied to the fan **144**.

As part of the control circuit **100**, a control power supply **148** can draw a low voltage power **156** from the fan power supply **142**. In one embodiment, a basic level of optical insulation can be provided by the fan power supply **142**. The fan power supply **142** can serve as a first stage of basic insulation. The control power supply **148** can serve as the second stage of basic insulation for the user accessible lower voltage (UALV) **158** to supply other control devices, such as a control pod **150**. The control pod **150** can provide a user interface **152** to the motor drive configuration **20**. Alternatively, or in addition to, a human interface module **154** can be coupled to the control pod **150** to allow a user to interact with the control pod **150** of the motor drive configuration **20**.

Based on user input to the control pod **150**, and/or the human interface module **154**, the control pod **150** provides the control signals **28** to a gate driver circuit **160** to control the operation of the inverter **132**. The inverter **132** is shown including only two IGBTs **162** and **164** for simplicity.

In one embodiment, the control pod **150** can also include a fan control circuit **202**. The fan control circuit **202** can couple to a fan controller **204** in line with the fan **144** to provide user control of the fan **144**. In order to maintain a basic level of insulation, a fan optocoupler **206** can be included between the fan controller **204** and the fan control circuit **202**.

In addition to the optocoupler **166** positioned between the control pod **150** and the gate driver circuit **160** to provide a basic level of insulation, an additive optocoupler **172** can be included in series with the optocoupler **166**. The additive optocoupler **172** can increase the level of insulation to a reinforced or double insulation level. For example, the optocoupler **166** can be a HCNW3120 optocoupler from Avago Technologies that can provide 8 mm of creepage clearance and 8 KV of impulse voltage protection. The additive optocoupler **172** can be a ACPL-W611 optocoupler, for example, also from Avago Technologies, that can provide an additive 8 mm of creepage clearance and 8 KV of impulse voltage protection between the control pod **150** and the gate driver circuit **160**. These two optocouplers **166** and **172** in series provide an additive creepage clearance and impulse voltage protection to achieve a reinforced or double level of insulation. It is to be appreciated that other optocouplers may be used.

The optocoupler **166** isolates a low voltage power **170** from the additive optocoupler **172** and a low voltage power **210** provided by the fan power supply **142**. The additive optocoupler **172** isolates a UALV **168** from the control pod **150** and the low voltage power **170** provided by the control power supply **148**. Optionally, a linear regulator **212** can be used to provide power to the additive optocoupler **172**. The linear regulator can reduce the low voltage power **156** down to a lower voltage, e.g., 5 VDC. Use of the linear regulator **212** can reduce the need for a transformer winding, saving space and cost. The UALV **158** and the UALV **168** need not be at the same lower voltage potential. The low voltage power **156** and the low voltage power **170** need not be at the same low voltage potential. The low voltage power **170** can be present between the additive optocoupler **172** and the optocoupler **166**.

For a 690V inverter, standards such as IEC 61800-5-1 require 8 mm optocouplers to provide a basic insulation between power circuits and the user, and 14 mm optocouplers to provide reinforced or double insulation between the power circuits and the user. In this example with a 690 VAC input power source **24**, the insulation necessary to achieve a reinforced or double level is 14 mm of creepage clearance and an impulse voltage protection of 12 KV. Thus, a reinforced or double level of insulation between the control pod **150**, which can be user accessible, and the power source **24** can be met or exceeded with the additive optocoupler **172** in combination with the optocoupler **166**.

FIG. **5** illustrates a more detailed wiring diagram of a portion of the block diagram of FIG. **4**. Specifically, FIG. **5** illustrates the wiring of the additive optocoupler **172** in series with the optocoupler **166**, and coupled to the gate driver circuit **160** for IGBT **162**, and an additive optocoupler **174** in series with an optocoupler **178**, and coupled to a gate driver circuit **176** for IGBT **164**. As can be seen, the UALV **168** can be coupled to both additive optocouplers **172** and **174**. In some embodiments, resistors **180** can be included in line with the UALV **168**, and resistors **180** can be included in line with the low voltage power **170** between the additive optocoupler **172** and the optocoupler **166**.

The low voltage power **170** can be provided to both additive optocouplers **172** and **174** in the form of a low voltage power **182** and a low voltage return **184**. The low voltage power **210** can be provided to the gate driver circuit **160** and the gate driver circuit **176** in the form of a low voltage power **216** and low voltage return **218**, along with gate driver signal **186** for the gate driver circuit **160**, and gate driver signal **188** for the gate driver circuit **176**.

In some embodiments, a third transformer/power supply can be eliminated to achieve reinforced or double Insulation, saving board space. The control power supply **148** can eliminate six of seven windings that were used for the gate driver circuit **160**. The remaining winding can be at a 5.0V potential. In this configuration, the control power supply **148** can provide a second stage of basic insulation. The control power supply may not have to meet a 12 KV impulse test, just an 8 KV test. The control power supply **148** may include a 24 V input, which could reference ground.

It is to be appreciated that the block diagram of the control circuits represent a system design, rather than an actual hardware installation.

This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

Finally, it is expressly contemplated that any of the processes or steps described herein may be combined, eliminated, or reordered. Accordingly, this description is meant to be taken only by way of example, and not to otherwise limit the scope of this invention.

We claim:

1. An electrical device having a power circuit, the device comprising:
- a first insulation device to provide a level of basic insulation between the power circuit and a user of the electrical device, wherein the first insulation device isolates a low voltage power from an additive insulation device and a high voltage power; and
- the additive insulation device in series with the first insulation device, the additive insulation device to increase the level of basic insulation to a level of double insulation or reinforced insulation between the power circuit and the user of the device, and wherein the additive insulation device isolates a user accessible low voltage from a control device and the low voltage power.

2. The electrical device according to claim **1**,
wherein the low voltage power is provided by a control power supply.

3. The electrical device according to claim **1**,
wherein the low voltage power is provided by a linear regulator.

4. The electrical device according to claim **1**,
wherein the electrical device comprises a variable speed motor drive.

5. The electrical device according to claim **4**,
wherein the additive insulation device is electrically positioned between a control pod and a gate driver circuit.

6. A variable frequency drive comprising:
- control circuitry coupled to a power circuit, a power module and an inverter,
- the control circuitry including a control pod and a gate driver circuit, the control pod to provide control signals to the gate driver circuit;
- the control circuitry including a first insulation device to provide a level of basic insulation between the power circuit and a user of the variable frequency drive; and
- the control circuitry including an additive insulation device, the additive insulation device to increase the level of basic insulation to a level of double insulation or reinforced insulation between the power circuit and the user of the variable frequency drive, the additive insulation being electrically positioned between the control pod and the gate driver circuit.

7. The variable frequency drive according to claim **6**,
wherein the first insulation device comprises an optocoupler.

8. The variable frequency drive according to claim **7**,
wherein the optocoupler is an 8 mm optocoupler.

9. The variable frequency drive according to claim **6**,
wherein the additive insulation device comprises an additive optocoupler.

10. The variable frequency drive according to claim **9**,
wherein the additive optocoupler is an 8 mm additive optocoupler.

11. The variable frequency drive according to claim **6**,
wherein the first insulation device and the additive insulation device each comprise an optocoupler.

12. A method for providing additive insulation to an electrical device having a power circuit, the method comprising:
- providing a first insulation device for providing a level of basic insulation between the power circuit and a user of the electrical device;
- providing an additive insulation device in series with the first insulation device, the additive insulation device for increasing the level of basic insulation to a level of double insulation or reinforced insulation between the power circuit and the user of the electrical device;
- using the first insulation device to isolate a low voltage power from the additive insulation device and a high voltage power; and
- using the additive insulation device to isolate a user accessible low voltage from a control device and the low voltage power.

13. The method according to claim **12**
wherein the electrical device comprises a variable speed motor drive.

14. The method according to claim **13**, further including electrically positioning the additive insulation device between a control pod and a gate driver circuit.

15. The method according to claim **12**,
wherein the first insulation device comprises an optocoupler.

16. The method according to claim **12**,
wherein the additive insulation device comprises an additive optocoupler.

17. The method according to claim **12**
wherein the low voltage power is provided by a control power supply.

18. The method according to claim **12**
wherein the low voltage power is provided by a linear regulator.

19. The method according to claim **12**

wherein the user accessible low voltage is coupled to a plurality of additive optocouplers.

* * * * *